CLAIMS

1. A high voltage AC transmission cable system (1) for transmitting power between two points (A, B) each connected to one or more power networks wherein at least one transformer is arranged at each end of an AC transmission cable, **characterised** in that at least one said transformer (3_A, 3_B) is arranged with a voltage control member capable of operating the transformer at a voltage whereby losses due to reactive power transport are minimized.

2. A system according to claim 1, **characterised** in that the system comprises a control member to operate said system at an optimal voltage dependent on the surge impedance of the cable (Z_V) and the instantaneous power level.

3. A system according to claim 1, **characterised** in that the system comprises a control member to operate said system at an optimal voltage dependent on an instantaneous power level equal to the Natural Load ($P_{natural}$) of the cable.

4. A system according to claims 1, **characterised** in that the system comprises a control member to operate said system at a voltage whereby the sum of the resistive losses, dielectric losses and charging losses are minimized.

5. A system according to any of claims 1-4, **characterised** in that the control member is arranged for communication with control equipment at both ends of said AC transmission cable.

6. A system according to any of claims 1-5, **characterised** in that the control member is arranged with control instructions for operation of said AC transmission cable under thermal overload conditions during limited periods of time.

7. A system according to any of claims 1-6, **characterised** in that the at least one said transformer is arranged to operate with a wide ratio of input voltage to output voltage of between 1:1 to 1:2, or greater.

8. A system according to any of claims 1-6, **characterised** in that the voltage control member in at least one said transformer (3_A, 3_B) is arranged with a tap-changer.

9. A system according to claim 1, **characterised** in that the voltage control member is a power electronic device which may be any of the list of: IGBT, IGCT, GTO, Thyristor, Diode.

10. A system according to claim 1, **characterised** in that the voltage control member is a mechanical tap-changer.

11. A system according to claim 10, **characterised** in that the tap-changer may further be a phase-shifting tap changer.

12. A system according to claim 1, **characterised** in that in that the voltage control member is comprised in an autotransformer.

13. A system according to claim 1, **characterised** in that the voltage control member is an autotransformer.

14. A system according to claim 1, **characterised** in that the at least one transformer is arranged to limit short-circuit currents.

15. A system according to claim 1, **characterised** in that the system is equipped with a high frequency filter.

16. A system according to claim 1, **characterised** in that at least one transformer winding may be arranged for fast short-circuit of a part of the transformer windings.

17. A system according to claim 1, **characterised** in that the cable reach may comprise one or more parallel cables (4a, 4b) for each phase, wherein each cable is arranged for rapid dis-connect and re-connect.

18. A system according to claim 18, **characterised** in that the cable system may comprise one or more breakers (5_A, 5_B) arranged for rapid dis-connect and re-connect.

19. A system according to claim 18, **characterised** in that the cable system may comprise one or more tap changer by-pass connectors (7, 8).

20. A system according to claim 1, **characterised** in that one or more AC transmission cables may be an oil and paper insulated cable.

21. A system according to claim 1, **characterised** in that said one or more AC transmission cables may be an XLPE insulated cable.

22. A system according to claim 1, **characterised** in that the system may be equipped with one or more over-voltage protection devices, phase-to-phase, phase-to-earth, depending on the cable.

23. A system according to claim 1, **characterised** in that the cable system may be equipped with one or more ways of protecting the sheath from overvoltage.

24. A system according to claim 1, **characterised** in that the cable system shield may be equipped with transposings and sheath sectionalizing insulators reducing shield induced currents.

25. A system according to claim 1, **characterised** in that at one end of the cable reach may be connected to one or more electrical machines (11) isolated from the rest of the system.

26. A system according to claim 25, **characterised** in that a transformer (10) arranged nearest the electrical machines (11) has a fixed transformation ratio or is equipped with off-load tap-changers only.

27. A system according to claim 25, **characterised** in that voltage regulation of the machines (11) is controlled according to the same natural load and minimize losses principle as it would be applied to a tap changer.

28. A method to control a high voltage AC transmission cable system for transmitting power between two points (A, B) connected to one or more power networks wherein at least one transformer (3_A, 3_B) is arranged at each end of an AC transmission cable (4), **characterised** by operating the cable with a variable voltage (V) which may differ from a voltage of said one or more power networks.

29. A method according to claim 28, **characterised** by regulating the voltage dependant on a function of the natural load of a said AC transmission cable, and so controlling the level of reactive power transported into any of said one or more power networks.

30. A method according to claim 28, **characterised** in that the voltage is regulated dependent on the natural load whereby losses at due to resistive, dielectric effects are minimised.

31. A method according to claim 30, **characterised** in that the voltage is regulated under no-load conditions so that losses are reduced while maintaining voltage above a lower, minimum voltage level depending on system conditions.

32. A method according to claim 30, **characterised** in that the voltage is regulated under low load conditions so that losses are reduced while maintaining voltage above a lower, minimum voltage level depending on system conditions.

33. A method according to claim 28, **characterised** in that the voltage is regulated dependent in part on an equation of the form:

$$V = \sqrt{Z_v \cdot P_{actual}}$$

where V is voltage, Z_v is the real part of the surge impedance and P_{actual} is the present active power flow.

34. A method according to claim 28, **characterised** in that the voltage is regulated dependent on thermal overload limits for the transmission cable (4) during limited periods of time.

35. A method according to claim 28, **characterised** by rapidly re-connecting and disconnect supply to and from at least two transmission cables (4a, 4b).

36. A method according to claim 28, **characterised** in that the voltage is regulated by more than one said transformer (3_A, 3_B) which are operated synchronously with each other.

37. Use of a high voltage AC transmission cable system for transmitting power between two points (A, B) according to

claims 1-27 as a power feeder for large, densely populated urban or suburban areas.

38. Use of a high voltage AC transmission cable system for transmitting power over a distance between two points (A, B) according to claims 1-27 in which a part of the distance is across water.

39. Use of a high voltage AC transmission cable system for transmitting power between two points (A, B) according to claims 1-27 wherein one point comprises one or more electrical machines isolated from an electrical power network.

40. A system for communication and control for a high voltage AC transmission cable system for transmitting power between two points (A, B) connected to one or more power networks wherein high speed data communication members are arranged for communication with control equipment for at least one transformer (3_A, 3_B) arranged at at least one end (A, B) of an AC transmission cable (4).

41. A graphical user interface (20) for controlling a high voltage AC transmission cable system for transmitting power between two points (A, B) connected to one or more power networks wherein at least one transformer (3_A, 3_B) is arranged at each end of an AC transmission cable (4), **characterised** by at least one object oriented applications for presenting data, parameter values and control actions for operating parameters (30, 31) of the AC transmission cable system and/or a control system for at least one transformer (3_A, 3_B).

CLAIMS

1. A high voltage AC transmission cable system (1) for transmitting power between two points (A, B) each connected to one or more power networks wherein at least one transformer is arranged at each end of an AC transmission cable, **characterised** in that at least one said transformer (3_A, 3_B) is arranged with a voltage control member capable of operating the transformer at a voltage dependent on the surge impedance of the cable (Z_V) whereby losses due to reactive power transport are minimized.

2. A system according to claim 1, **characterised** in that the system comprises a control member to operate said system at an optimal voltage dependent on the surge impedance of the cable (Z_V) and the instantaneous power level.

3. A system according to claim 1, **characterised** in that the system comprises a control member to operate said system at an optimal voltage dependent on an instantaneous power level equal to the Natural Load ($P_{natural}$) of the cable.

4. A system according to claims 1, **characterised** in that the system comprises a control member to operate said system at a voltage whereby the sum of the resistive losses, dielectric losses and charging losses are minimized.

5. A system according to any of claims 1-4, **characterised** in that the control member is arranged for communication with control equipment at both ends of said AC transmission cable.

6. A system according to any of claims 1-5, **characterised** in that the control member is arranged with control instructions for operation of said AC transmission cable under thermal overload conditions during limited periods of time.

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24. A system according to claim 1, **characterised** in that the cable system shield may be equipped with transposings and sheath sectionalizing insulators reducing shield induced currents.

25. A system according to claim 1, **characterised** in that at one end of the cable reach may be connected to one or more electrical machines (11) isolated from the rest of the system.

26. A system according to claim 25, **characterised** in that a transformer (10) arranged nearest the electrical machines (11) has a fixed transformation ratio or is equipped with off-load tap-changers only.

27. A system according to claim 25, **characterised** in that voltage regulation of the machines (11) is controlled according to the same natural load and minimize losses principle as it would be applied to a tap changer.

28. A method to control a high voltage AC transmission cable system for transmitting power between two points (A, B) connected to one or more power networks wherein at least one transformer (3_A, 3_B) is arranged at each end of an AC transmission cable (4), **characterised** by operating the cable with a variable voltage (V) dependent on the surge impedance of the cable (Z_V) which may differ from a voltage of said one or more power networks.

29. A method according to claim 28, **characterised** by regulating the voltage dependant on a function of the natural load of a said AC transmission cable, and so controlling the level of reactive power transported into any of said one or more power networks.

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